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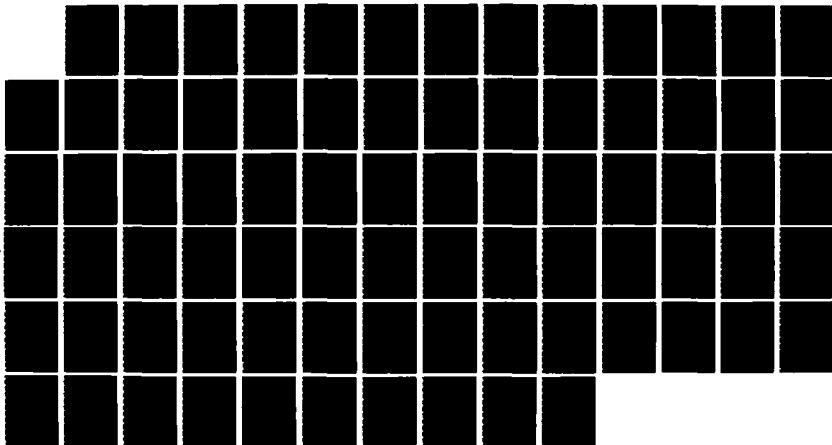
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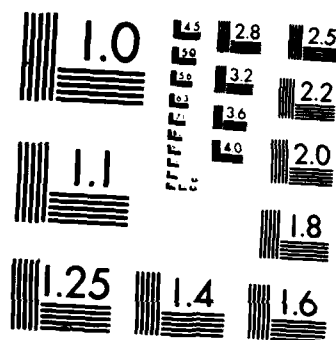
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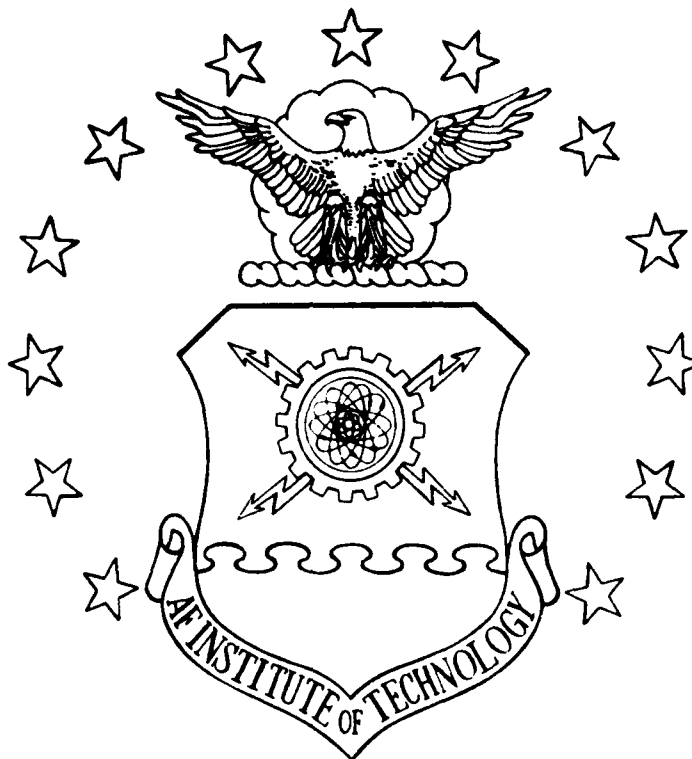




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OF SPARE PARTS

THESIS

Michael O. Yorke
Captain, USAF

AFIT/GLM/LSQ/86S-91

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COST ALLOCATION AND OVERPRICING
OF SPARE PARTS

THESIS

Presented to the Faculty of the School of Systems and Logistics
of the Air Force Institute of Technology
Air University
In Partial Fulfillment of the
Requirements for the Degree of
Master of Science in Logistics Management

Michael O. Yorke, B.S.
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Michael O. Yorke

Table of Contents

	Page
Acknowledgements	ii
List of Tables	v
Abstract	vi
I. Introduction	1
General Issue	1
Glossary	2
Specific Problem	4
Investigative Questions	5
II. Literature Review	6
Cost Allocation Process	6
Cost Objectives	7
Cost Pools	9
Cost Allocation Bases	13
Spare Parts Overpricing	16
Number of Departmental Rates	21
Spares Overpricing Problem Redefined	22
Line Item Price Distributions	23
Air Force Contract Management Division (AFCMD) ..	25
Spare Parts as Cost Objectives - An Example	26
Commercial vs. Government Spare Parts Costing ...	31
Summary	32
III. Methodology	34
Justification	34
Instrument	34
Sample	35
Data Collection	36
Analysis Plan	38
Assumptions	38
Limitations	39
IV. Findings and Analysis	40
Introduction	40
Investigative Question 1	40
Investigative Question 2	41
Investigative Question 3	42
Investigative Question 4	43
Investigative Question 5	44
Investigative Question 6	46
Investigative Question 7	51

	Page
V. Conclusions and Recommendations	54
Introduction	54
Review	54
Recommendations	56
Appendix A: Survey Questionnaire	58
Bibliography	64
VITA	66

List of Tables

Table	Page
I. Plantwide Overhead Rate Versus Departmental Overhead Rates	10
II. Overhead Rate Calculation	12
III. Comparison of Overhead Application to Product When Bases Are Used Proportionately	14
IV. Overhead Allocation Bases	16
V. Material Handling Labor Hours Allocated Evenly to Each Spares Line Item	18
VI. Material Handling Labor Hours Prorated on Basis of Total Purchased Parts Cost	19

Abstract

thesis
The ~~research~~ objective was to determine if it is feasible to treat spare parts in lieu of contracts as cost objectives in government spare parts contracts. A survey instrument was constructed to help answer the research question. Survey was administered to contractor representatives of 12 major defense companies.

The analysis revealed that 5 defense contractors are presently treating spare parts as cost objectives and using a type of spare parts accounting system as described in the survey instrument. The other 7 contractor respondents who do not treat spare parts as cost objectives were not favorable to this accounting treatment. Also within this group, most anticipated significant increases in accumulating contract costs in order to treat spare parts as cost objectives. The anticipated cost impact was less severe in estimating contract costs.

The results of this exploratory research based on the limited data from a small number of large defense contractors supports the conclusion that treating spare parts as cost objectives is feasible for some companies. However, more detailed research is required to fully assess the impact and practicality of treating spare parts as cost objectives.

COST ALLOCATION AND OVERPRICING OF SPARE PARTS

I. Introduction

Overpriced spare parts have filled newspaper headlines during the last three years. Reasons for the overpriced spare parts are many including stringent specifications, uneconomical order quantities, allowability of costs and unreliable cost allocation techniques (1:4).

This research report will focus on the cost allocation problem as it relates to the overpricing of spare parts. Brig Gen John D. Slinkard (AFSC) in addressing conferees at Aeronautical System Division's Ninth Annual Pricing Symposium stated:

Much of the criticism leveled at us revolves around the way we price defense products and threatens the credibility of both government and contractor procurement functions (2:1).

General Issue

The Air Force Management Analysis Group (AFMAG) - Spare Parts Acquisition Study stated:

...non-value based cost allocation methodologies whether applied in company accounting systems or used to resolve specific contract or formula pricing cost allocation issues, contribute significantly to overpricing of individual spare parts and misrepresentation of realistic individual spare part prices (3:118).

The report revealed total contract costs are reasonable, but the allocation of total contract costs to individual spare parts has distorted unit price integrity. Maj Gen Weiss, the former Director, Contracting and Manufacturing

policy (AF/RDC) commenting on the problem on allocating contract costs stated:

...the problem is that they do not have a causal relationship between the value of the part and the indirect costs that are associated with the buying, making, producing, and testing of that part (4:13).

Lieutenant General Leo Marquez, Deputy Chief of Staff, Logistics and Engineering, HQ USAF, remarking on AFMAG report and pricing techniques stated:

We have not done a good job of allocating the aggregate contract cost to individual items. This has tended to distort the item price particularly on low value items which, not surprisingly, are the easiest to make the hardware store comparisons (5:11).

The AFMAG study recommended the use of value-based allocation techniques to help restore unit price integrity in spare parts pricing (3:118). Brig Gen Slinkard is also requiring a 100% value review of spare parts to help catch unrealistic prices, but stated "this is a very resource intensive activity, and we have to find better ways to accomplish this activity" (2:27).

This research effort is directed at answering the management question of "Can we improve on pricing spare parts through better cost allocation techniques?"

Glossary

This glossary explains key terms used throughout this research report.

Actual Cost: "A cost sustained in fact, on the basis

of cost incurred, as distinguished from forecasted or estimated costs" (6:1A-B1).

Allocate: To assign an item of cost, or a group of items of cost, to one or more cost objectives. This term includes both direct assignment of cost and the reassignment of a share from an indirect cost pool (7:111).

Cost Objective: A function, organizational subdivision, contract, or other work unit for which cost data are desired and for which provision is made to accumulate and measure the cost of processes, products, jobs, capitalized projects, etc. (7:111). A cost objective can also be defined as any activity for which a separate measurement of cost is desired, i.e., a product, service, project, or a group of products (8:20). A final cost objective has allocated to it both direct and indirect costs and, in the contractor's accumulation system, is one of final accumulation points (7:111A).

Cost Pool: Often used to describe any grouping of individual costs. Subsequent allocations are made of cost pools rather than individual costs. Costs are frequently pooled by departments (engineering, assembly, inspection, etc.), but they can also be pooled by natural categories (materials-related, people-related, etc.) or by behavior pattern (variable or fixed costs) (8:496).

Cost Allocation Base: A systematic means of relating a given cost or cost pool with a cost objective. The cost to be allocated is related to an allocation base that is a common denominator identifiable with the cost objectives in question (8:497-498).

Direct Cost: Any cost which is identified specifically with a particular final cost objective. Direct costs are not limited to items which are incorporated in the end product as material or labor. Costs identified specifically with a contract are direct costs of that contract (7:111).

Indirect and Direct Cost Allocation: This category includes all indirect and direct cost allocations which are made to the overall contract in accordance with the Cost Accounting Standards (9:1).

Indirect Cost: Any cost not directly identified with a single final cost objective, but identified with two or more final cost objectives or with at least one intermediate cost objective (7:112).

Line Item Price Dis'ributions: This category refers to the division of contract price between individual contract line items (9:2).

Specific Problem

Matz and Usry have reported that departmentalization of factory overhead "provides more accurate costing of jobs and products and responsible control of overhead costs" (10:235). Departmentalization of overhead means different departmental or cost center rates are used to apply overhead to products. A product during the manufacturing process is charged with overhead as it passes through those departments from which it receives benefits. The product is not charged with overhead from departments which it does not pass through. Matz and Usry portray products as the cost objectives and overhead is applied to the products with recognition of the cost differentials among products. However, in government spare parts contracts the contract is the cost objective and the emphasis is on estimating, accumulating, and reporting costs for the overall contract. If the spare parts were the cost objectives, it seems reasonable to hypothesize that more accurate determination of unit costs and prices of spare parts is possible.

The research question or objective then is to determine if it is feasible to have spare parts become the cost objectives in government spare parts contracts.

Investigative Questions

To help answer the research question, the following investigative questions were formulated to guide this research effort:

1. Do any large defense companies presently use a type of spare parts accounting-cost accounting system that treats spare parts as cost objectives in order to determine unit costs?
2. What will be the initial cost impact on a company's estimating practices if spare parts are treated as final cost objectives?
3. What will be the initial cost impact on a company's cost accumulating practices if spare parts are treated as final cost objectives?
4. What will be the recurring cost impact on a company's cost estimating practices if spare parts are treated as final cost objectives?
5. What will be the recurring cost impact on a company's cost accumulating practices if spare parts are treated as final cost objectives?
6. Does treating spare parts as cost objectives provide a cost effective alternative of determining more accurate unit prices of spare parts compare to contract cost objective accounting?
7. Does treating spare parts as cost objectives have an impact on the overall accuracy of the estimated contract price?

II. Literature Review

Cost Allocation Process

To understand how cost allocation procedures have contributed to overpricing it is necessary to first understand the traditional cost allocation process as reported in accounting literature. Horngren reported there are essentially three facets of cost allocation as follows:

1. Choosing the cost objective (the independent variable), which is essentially an action. Examples are products, contracts, or departments.
2. Choosing and accumulating (pooling) the costs (the dependent variable) that relate to the cost objective. Examples are the material, labor and overhead costs of making a product, as well as the manufacturing expenses of selling and administration.
3. Choosing a method for specifically identifying 2 (dependent variable) with 1 (independent variable). For allocating manufacturing costs, this entails choosing a cost allocation base, which is usually direct-labor hours, machine hours or direct labor cost (8:495).

"The typical accounting textbook portrayal of product cost allocation presents a multi-department manufacturing concern with several service and production departments"

(11:74). Determining product cost entails charging a product with direct materials, direct labor, and a share of factory overhead as the product passes through each department or cost center in a factory. Horngren states that a cause-and-effect relationship should exist between the cost objective and the allocation base. Further, "the existence of the cost objective should be the dominant factor in

causing the incurrence of the costs in question" (8:495). These three facets of cost allocation will be examined further to fully understand the cost allocation process.

Cost Objectives

The Cost Accounting Standards define a cost objective as:

A function, organizational subdivision, contract, or other work unit for which cost data are desired and for which provision is made to accumulate and measure the cost of processes, products, jobs, capitalized projects, etc. (7:111).

Cost objectives may be further broken down into intermediate and final cost objective categories (8:497). For example, costs may be first allocated to the service and production departments as intermediate cost objectives. Then these department costs are further allocated to a particular job order for the manufacture of a certain product. The job order can be considered the final cost accumulation point or cost objective. However, costs may be further allocated to the individual units of the product if the job order is for more than one unit of a product.

Horngren reports cost accounting systems commonly have two major cost objectives: departments and products (8:75). The departments, or cost centers, represent the smallest part of the organization for which costs are accumulated and as mentioned earlier are often considered intermediate cost objectives. The other major cost

objective Horngren speaks about is the allocation of "department costs to the physical units (or other measures of output, that pass through the departments" (8:75).

One of the major reasons products are cost objectives is to determine inventory cost of the finished product (8:20-21). Product cost data also help make determinations concerning which products to manufacture or buy from another firm, product prices, manufacturing methods, etc. According to Matz and Usry:

...because the total cost figure is considered unsatisfactory from a control point of view, a cost unit must be found that most adequately conforms both to the type of product and the manufacturing processes (10:93).

For example, a liquid product such as oil is measured by the barrel, lumber by board feet, and products such as airplanes, equipment, shoes, or hats are measured by the individual unit or by multiples thereof. Matz and Usry caution that the cost unit must be neither too large or too small. A cost unit that is too large may hide significant cost trends while a cost unit that is too small may not be justified by the cost of the added information.

It should be noted that spare parts if called products or otherwise are not treated by the Cost Accounting Standards as cost objectives (11:3). Instead, spare parts are grouped together under one contract for procurement with the contract as a whole considered the cost objective. This arrangement may lead to difficulties in allocating costs to

spare parts which will be examined later in detail in this chapter.

Cost Pools

Cost Pools are used to describe any grouping of individual costs (8:496). Costs are usually pooled by departments or cost centers of a company. Matz and Usry describe this pooling scheme as departmentalization of overhead (10:235). Matz and Usry indicate departmentalization of overhead provides more accurate costing of products or cost objectives than single plant-wide rates. This is possible because different departmental overhead rates are used to apply factory overhead. Likewise, Horngren reports:

...when products are heterogeneous, receiving uneven attention and effort as they move through various departments or cost centers, departmental or cost center overhead rates are necessary to achieve more accurate product costs (8:531).

The significance of using a single plant-wide overhead rate versus departmental overhead rates can be illustrated in Table I (8:530). Assume a company has two manufacturing departments: machining and finishing. The machining department is heavily automated with expensive equipment. The finishing department depends more on skilled labor with some few simple hand tools. Thus, overhead is relatively large in the machining department compared to the finishing department. Further assume the company is working on two jobs. The cost allocation base for both jobs is direct labor hours. For Job No. 1, one hour of machining time is

TABLE I
PLANTWIDE OVERHEAD RATE VERSUS DEPARTMENTAL OVERHEAD RATES (8:530)

	<u>PLANTWIDE RATE</u>		<u>DEPARTMENTAL RATES</u>	
	<u>Maching</u>	<u>Finishing</u>	<u>Maching</u>	<u>Finishing</u>
Budgeted annual overhead	\$100,000	\$ 8,000	\$100,000	\$ 8,000
Direct-labor hours	10,000	10,000	10,000	10,000
Plantwide rate per DLH:				
$\$108,000 \div 20,000$		\$ 5.40		
Departmental rates per DLH			\$ 10.00	\$.80
Overhead application:				
Job No. 1				
Labor time, 11 hours @ \$5.40		\$59.40		
or				
Labor time:				
Machining, 1 hour @ \$10.00			\$ 10.00	
Finishing, 10 hours @ \$.80				.80
Job No. 2				
Labor time, 11 hours @ \$5.40		\$59.40		
or				
Labor time:				
Machining, 9 hours @ 10.00			\$ 90.00	
Finishing, 2 hours @ \$.80				1.60
				\$ 1.60
				\$91.60

required and ten hours of finishing time. Using a single overhead rate for Job No. 1, overhead allocation amounts to \$59.40 and using departmental rates overhead application amounts to \$18.00. The \$18.00 overhead amount is a more accurate cost amount since it is not heavily weighted with machine time which only contributed one hour for production for Job No. 1. On the other hand, use of the single plant-wide rate for Job No. 1 results in a higher overhead amount of \$59.40 which is heavily weighted with machine time. Thus, Job No. 1 may well end up overpriced using the single allocation base.

Use of a single overhead rate can also lead to an underpriced product. Assume for Job No. 2, nine hours of machining time are required and two hours of finishing time. Using a single plant-wide rate, overhead allocation amounts to \$59.40 and using departmental rate overhead application amounts to \$91.60. Use of the single overhead base for Job No. 2 may not reflect the true cost contribution of the hours of machining time. However, the departmental rates do more accurately reflect the benefits received from each department respectively. In summary, use of the single allocation base or rate results in both jobs receiving the same amount of overhead while the use of departmental overhead rates results in overhead allocation that more truly reflects the cost differentials between the two jobs.

TABLE II
OVERHEAD RATE CALCULATION (13:47)

<u>Method</u>	<u>% Using Method</u>
Single plant-wide O.H. rate	34
Plant-wide fixed and variable O.H. rates	14
Departmental total O.H. rates	28
Departmental fixed and variable O.H. rates	29
Other	7

Zimmerman provides further support of departmental overhead rates by reporting that "the typical textbook portrayal" of a product costing situation is:

...each department's overhead costs as well as the department's share of the service department's costs are allocated to each job by using direct labor hours as the allocation base (12:505).

Schwarzbach recently reported the results of a survey on overhead practices of 112 manufacturing firms (13:45). The questionnaire was sent to companies with sales ranging from \$10 million to "many Fortune 500 companies with sales in the billions" (13:45). Table II shows the percentage of firms using various allocation methods. The total percentage exceeds 100% because some firms used more than one cost allocation method. Table II indicates that 48% of the companies used the single plant-wide rate including those companies who broke the plant-wide rate into fixed and variable components. Although almost half the companies responding to the survey used the single allocation rate,

Schwarzbach cautions "in many situations a plant-wide rate provides meaningless unit cost figures" (13:47). Departmental overhead rates was the dominate method used by companies: 57% of the companies responding to the survey. Companies using total departmental overhead rates had departments ranging from 2 to 200 departments and the median number was 10. Companies using departmental fixed and variable overhead rates tended to have more departments and the median number was 20.

Cost Allocation Bases

Horngren's third facet of the cost allocation process is deciding on the cost allocation bases, "which is a systematic means of relating a given cost or cost pool with a cost objective" (8:497). Matz and Usry state:

the primary objective in selecting a base is to insure the application of factory overhead in a reasonable proportion to the beneficial or causal relationship to jobs, products, or work performed (10:207).

This concept can be illustrated by considering the example in Table III (8:534). The cost objective is the product and the total overhead pool is \$100,000. The goal is to apply the overhead pool to the products in proportion to the benefits the products receive from the overhead. Horngren lists four possible bases in this example to apply overhead: direct materials, direct-labor hours, direct-labor cost and machine hours. In this example, all four possible bases have rates that yield the same amount of

TABLE III

COMPARISON OF OVERHEAD APPLICATION TO PRODUCT
WHEN BASES ARE USED PROPORTIONATELY (8:534)

ANNUAL OVERHEAD BUDGET DATA:		TOTAL	POSSIBLE RATES
Total overhead		\$100,000	50% of direct-labor cost
Direct-labor cost		\$200,000	\$1.00 per DLH
Direct-labor hours		100,000	25% of direct materials
Direct-material usage		\$400,000	\$5.00 per machine-hour
Machine-hours		20,000	
Job data:			
Job No. 1			
Direct-labor hours	5		
Machine hours	1		
Direct materials	\$ 20		
Direct-labor cost	10		
Prime cost	\$ 30		
POSSIBLE OVERHEAD APPLICATION USING FOLLOWING BASES			
		Direct-Labor	Direct-Labor Machine-Hours
		Hours	Cost
Overhead	5	\$1.00 (5hr.) = \$5	.50 (\$10) = \$5 1hr. (\$5) = \$5
Total job cost	\$ 35		
Job No. 2			
Direct-labor hours	25		
Machine-hours	5		
Direct materials	\$100		
Direct-labor cost	50		
Prime cost	\$150		
Overhead	25	.25 (\$100) = \$25 \$1.00 (25hr.) = \$25 .50 (\$50) = \$25 5hr. (\$5) = \$25	
Total job cost	\$175		

overhead application "because all bases are used proportionately" (8:535). However, if the base used does not result in applying overhead in relation to the benefits received by the product, then the product may be charged with inaccurate amounts of overhead. Horngren reports the best base can be chosen arbitrarily or by statistical regression analysis. "As long as all the possible causal factors are used in the same proportions on individual jobs, each job will get" its fair share of overhead (8:533). For example, if the overhead cost pool consists mostly of management salaries and indirect labor, direct labor hours may be an appropriate base since the overhead is labor oriented.

Before the Cost Accounting Standards Board was disbanded, the board reported on allocation bases used by companies with a manufacturing overhead pool covered by the Cost Accounting Standards (8:535). "254 (73 percent) use the direct-labor dollars base, 50 (15 percent) use the direct-labor hours base, and 12 percent use a variety of other bases" (8:535). Schwarzbach reported on the frequency of allocation bases used by the 112 manufacturing (13:45). His survey findings are shown in Table IV. The total exceeds 100% because some companies use more than one allocation base. The survey also revealed the reasons why the companies used certain bases. 79% said "There is a logical association between the basis and the overhead,"

TABLE IV
OVERHEAD ALLOCATION BASES (13:47)

<u>ALLOCATION BASE</u>	<u>% OF FIRMS USING THE BASE</u>
Direct labor hours	35.7
Direct labor dollars	58.0
Machine hours	27.7
Direct material cost	18.8
Weight	11.6
Other bases	8.9

13% said "We found a statistical relationship between the basis and the overhead" and 3% chose the "other" category (13:47). Schwarzbach concluded that the "responses imply that most cost accountants are not performing rigorous analyses of overhead cost behavior for determining product costs" (13:47). Apparently, accountants are relying on a "logical relationship" rather than statistical testing to determine choice of allocation bases. Schwarzbach also reported that production managers participating in the survey said their cost allocation data serves as input data into their CAD/CAM systems. Schwarzbach cautions "production engineers may be using high-tech equipment and software with low-tech accounting data and emphasizes the need for accountants and engineers to validate cost allocation data statistically" (13:50).

Spare Parts Overpricing

The previous discussion focused on basic cost allocation

theory and empirical research results on cost allocation practices. This background should help in understanding how cost allocation works in government contracts and has contributed to the overpricing of spare parts.

The AFMAG report, completed in October 1983, was prepared in response to the growing concern over spare parts overpricing. The report identified "non-value based cost allocation methodologies" as contributing "significantly to overpricing of individual spare parts and misrepresentation of realistic individual spare part prices" (14:2-33). The report indicated "most major defense contractors allocate their costs by prorating the cost equally to each line item of the spare parts order" (14:2-33). This cost allocation technique was illustrated in the report by an example shown in Table V. Table V portrays a simple contract for 6 power supplies and 2 diodes. Beginning at the top of the table, purchased parts represent total material costs for each line item. Next, total material handling labor hours for this contract was estimated at 9 hours, 18 dollars an hour. Since there are only 2 line items in this illustrated contract, per-unit allocation divides the total of 9 hours by 2 and allocates 4.5 hours of material handling labor to each line item. The hours are then multiplied by the material handling labor hour rate and so allocates \$81.00 to each line item. Because material handling labor hours were allocated

TABLE V

MATERIAL HANDLING LABOR HOURS ALLOCATED EVENLY
TO EACH SPARES LINE ITEM (3:117).

	<u>Diode</u>	<u>Power Supply</u>
Purchased Parts 2 @ 4¢ \$.08 6 @ \$100 \$ 600.00		
Direct Labor Negotiated		
4.5 hours @ \$18.00	81.00	81.00
Overhead @ 94%	76.14	76.14
Total Mfg Cost	\$ 157.22	\$ 757.14
G&A @ 21%	33.02	159.00
Subtotal	\$ 190.24	\$ 916.14
Profit @ 16%	30.44	146.58
Total Price	\$ 220.68	\$1,062.72
Unit Price	\$ 110.34	\$ 177.12

evenly to each line item the relatively inexpensive diode is now overpriced and the power supply underpriced. This method has been widely used by contractors in order to speed up the pricing process. Matz and Usry called this allocation method the "units of production" method and caution that it is only useful when a company is manufacturing one product (10:208). The remaining entries in the table only compound the error just described. Factory overhead is applied using the material handling labor hours cost of \$81.00. Similarly, general and administrative overhead (G&A) and profit are added on further compounding the error.

TABLE VI
MATERIAL HANDLING LABOR HOURS PRORATED ON BASIS OF
TOTAL PURCHASED PARTS COST (3:117).

	<u>Diode</u>	<u>Power Supply</u>
Purchased Parts 2@ .04¢	\$.08	6@ \$100 \$ 600.00
Direct Labor	.02	161.98
Overhead @ 94%	.02	152.26
Total Mfg Cost	\$.12	\$ 914.24
GSA @ 21%	.03	191.99
Subtotal	\$.15	\$ 1,106.23
Profit @ 16%	.03	176.99
Total Price	\$.18	\$ 1,283.22
Unit Price	\$.09	\$ 213.87

Total contract price is reasonable however, since the overpriced diode and underpriced power supply offset each other. In other words, the 9 hours of material handling labor cost estimated for the contract has been recovered, but it is the distribution of those hours among the two line items that has resulted in the distortion of unit prices. To correct the distortion created by the per unit allocation or units of production method of allocating costs, the Air Force Management Analysis Group (AFMAG) recommended contractors switch to a value-based cost allocation method (3:118). The AFMAG report illustrated this method by using the same simple example of the contract for the diodes and power supply as exhibited in Table VI. Under the heading of direct labor, material handling labor

hour costs are now prorated on the basis of purchased parts cost. Now, factory overhead, G&A, and profit rates will be applied against a base that is more representative of the value of the item. Unit price integrity has been restored or at least improved. The use of value-based allocation methods has recently been mandated by a new "Integrity of Unit Prices" clause in the Federal Acquisition Regulation, FAR 52.215-26, which requires contractors to:

...distribute costs within contracts on a basis that ensures that unit prices are proportional to the items' base cost (e.g., manufacturing or acquisition cost) (15:220).

The use of value-based techniques as illustrated in the AFMAG report and Table VI appear to be an improvement in attaining the goal of unit price integrity for spare parts. However, in the Table VI example, one allocation rate, 94% of direct labor cost, is used to apply overhead to the parts. As reported earlier in this report, Horngren argues the use of departmental rates as oppose to the single plantwide overhead rate leads to more accurate product costing when the products are heterogeneous (8:531). In Table VI, if we accept that the power supply and diode are essentially different types of products or spare parts, requiring different amounts of manufacturing overhead processes, then the use of departmental overhead rates should be appropriate and lead to more accurate product costing. This argument was illustrated in Table II, Plantwide Overhead Rate versus Departmental Overhead Rates.

Number of Departmental Rates

How many departmental overhead rates or cost pools to apply overhead should be used such as in the AFMAG example in Table VI? To help answer this question requires a understanding of the concept of homogeneity. Cost Accounting Standard (CAS) 418, Allocation of Indirect Cost Pools, emphasizes that cost pools should be homogeneous (16:5698). CAS 418 states:

An indirect cost pool is homogeneous if each significant activity whose costs are included therein has the same or a similar beneficial or casual relationship to cost objectives as the other activities whose costs are included in the cost pool. It is also homogeneous if the allocation of the costs of the activities included in the cost pool result in an allocation to cost objectives which is not materially different from the allocation that would result if the costs of the activities were allocated separately (16:5698).

Many contractors expressed concern that the above CAS pronouncement would lead to an "unnecessary proliferation of indirect cost pools" and increase contract accounting costs without any measurable benefit" (17:327). However, the CAS Board emphasized the materiality aspect of the pronouncement and said additional indirect cost pools would only be required "if the changes result in materially different allocations of cost" (17:326).

Anderson claims homogeneity can be tested and measured using CAS 418 guidance to determine the number of cost pools used to apply overhead (18:27-14). Allocation of costs to

cost objectives using aggregated or combined rates can be compared to allocation of costs to cost objectives using disaggregated or separate rates. If there are no differences between the aggregated and disaggregated rates the simpler or aggregated rate can be used to allocate costs.

Using CAS 418 guidance and testing techniques for homogeneity would appear to solve most problems concerning cost allocation of overhead to spare parts and the determination of the number of cost pools. However, as Anderson points out, homogeneity refers to all three factors of the cost allocation process as explained in the beginning of this chapter: cost objectives, cost pools, and cost allocation bases (18:27-13). It soon became apparent after the AFMAG study was released that the cost objective factor was also playing a major role in spare parts overpricing and cost allocation problems.

Spares Overpricing Problem Redefined

Further analysis by the Air Force Contract Management Division (AFMCD) broke the cost allocation problem into two separate categories of problems: (1) "indirect and direct cost allocation" and (2) "line item price distributions" (9:1).

The indirect and direct cost allocation category "includes all indirect and direct cost allocations which are made to the overall contract" (9:1). The Cost Accounting Standards, especially CAS 418, Allocation of Direct and

Indirect Costs, provides regulatory guidance to contractors on how best to make these allocations to the contract. This guidance includes the determination of the number of cost pools and the proper choice of allocation bases: two of the three factors of the cost allocation process. The third factor, selection of the cost objective, is a fixed property of government contracts in that the Cost Accounting Standards view the contract as the cost objective (11:10). The fact that contracts are cost objectives and not spare parts or products within contracts contributed to the recognition by AF/RDC of the second category of problems dealing with cost allocation in government spare parts contracts: line item price distributions.

Line Item Price Distributions

AF/RDC defines the line item price distributions category as follows:

This category refers to the division of contract price between individual contract line items. These distributions are made after all normal indirect and direct cost allocations have already been made to the overall contract. The contractors cost accounting system disclosure statement usually does not address these distributions. The distribution methodology is often worked out at the time of contract negotiation. Problems occur when these distributions are made in an arbitrary manner. Frequently the amounts to be distributed are determined by simply dividing by the number of line items. This can result in grossly over or under valued items (9:1).

As Anderson points out, these line item price distributions are not technically cost allocations (18:27-49). However,

both line item price distributions and cost allocations have the objective of spreading costs to a work unit: cost allocations to the contract and price distributions to the spare parts. So, the contract is the recognized cost objective, but spare parts may also be considered by some as cost objectives since the goal is to achieve realistic costs and prices of the spare parts as well as the contract.

AF/RDC believes "strict enforcement of the Cost Accounting Standards" will help solve problems associated with the indirect and direct cost allocation category (9:2). However, the line item price distributions require a different solution or approach since the Cost Accounting Standards apply only to the cost allocation category. For the line item price distributions, AF/RDC recommended:

...if possible, line item price distributions should be made using the same base as contract cost allocations. If this is not possible, then a substitute base should be used which meets the basic requirements of CAS 418 (9:3).

The call for using an allocation base that meets CAS requirements appears to be a big improvement in distributing contract costs to spare parts. However, Horngren remarks, homogeneity refers to all three factors of the cost allocation process: allocation bases, cost pools, and cost objectives (8:531). All three factors are interdependent and one cannot make changes in one of the factors without considering the effect the change has on the other

two factors. Anderson has also echoed Horngren's position by stating "CASB's concept of homogeneity leads one to consider simultaneously the three crucial factors in cost allocation" and "the concept cannot be applied, however, without consideration of all three elements" (18:27-13).

In the spirit of the above remarks by Horngren and Anderson, this research effort was undertaken. That is, to determine if one of the other factors of the cost allocation process, namely the cost objectives, should be modified to achieve more realistic prices for spare parts. Of course, changing the cost objective to a smaller work unit, from the contract to the individual spare parts, may also lead to an increase number of cost pools and overhead rates. Since cost pools that were homogenous when the contract was the cost objective may no longer be homogenous when the spare parts are the cost objectives. Spare parts as cost objectives may force the departmentalization of overhead into more disaggregated overhead rates in keeping with the concept of homogeneity and the goal of achieving realistic spare part prices.

Air Force Contract Management Division (AFCMD)

AFCMD, Headquarters for all Air Force Plant Representative Offices (AFPROs), has also established a number of initiatives to improve cost allocation practices and pricing of spare parts. AFCMD requires all AFPROs to accomplish an "item-by-item value review of all spares and support

equipment proposals" subject to limitations in AFCMDR 540-19 (19:1). AFCMD defines a "value review as the "process by which a subjective assessment is made to determine whether the intrinsic value of an item is commensurate with the price being proposed by the contractor" (19:1). A disadvantage of value reviews is they are a "very resource intensive activity" (2:27). Although value reviews may identify absurd prices for spare parts, the reviews don't purport to correct problems in the basic cost allocation process. AFCMD also recommends in regards to allocation of spare parts costs that:

...if the contractor's present cost allocation system results in inequitable allocations, the contractor shall be encouraged to initiate mutually agreed to accounting changes under paragraph (a)(4)(c) of the Cost Accounting Standards Clause (19:2).

Spare Parts as Cost Objectives - An Example

Although "the Cost Accounting Standards view contracts rather than products as being cost objectives", this view has not prevented some companies from treating spare parts as cost objectives (11:10). Anderson explains that a contractor may have cost objectives that perform work only for other cost objectives, some that perform work for other cost objectives and for contracts, and some that perform work only on contracts (18:11-6). A common element among the different types of cost objectives is that costs can be traced or identified to the cost objective. A primary cost

objective is defined as a cost objective accumulating only costs directly traceable to it and having its costs reallocated to other cost objectives (18:11-6). Anderson also notes concerning final cost objectives:

A final cost objective does not have to be a last cost objective (although it usually is) in the cost accumulation process. Rather, a final cost objective is an accumulation point that is near the end of, and the primary purpose for the cost accumulation process. For example, a process cost center may be a final cost objective in a process cost system, instead of the contract or product (18:11-6.1).

Texas Instruments (TI), Inc., is an example of a company whose cost accounting system treats spare parts as cost objectives. Details and practices of TI's cost accounting system were revealed in a published case decided by the Armed Services Board of Contract Appeals (ASBCA) (16:9338). The case centered around a firm fixed-price contract for parts of the U.S. Navy's forward looking radar system (APQ-126). The radar consists of more than 6,000 different parts. The government's position was Texas Instruments was in noncompliance with Cost Accounting Standard 401, Consistency in Estimating, Accumulating, and Reporting Costs. CAS 401 requires "the contractor's practices used to estimate costs in pricing proposals must be consistent with practices used in accumulating actual costs" (20:819). The government maintained since the company submitted its estimate of proposed costs on DD Form 633, Contract Pricing Proposal, likewise, the company must accumulate and report

costs on a single contract basis. According to the government, use of the Contract Pricing Proposal form by the company implied the estimating, accumulating, and reporting of costs by individual contract (16:9338).

On the other hand, Texas Instruments argued its estimating, accumulating, and reporting of costs was based on product line accounting and was consistent with CAS 401 (16:9338-9357). "Use of the Contract Pricing Proposal form "was only the end product of estimating" (16:9338). The company also stated the government:

...has improperly and erroneously equated the form of the proposal with estimating practices and thus, in effect, asserted that accumulated cost must be consistent with the form of the proposal (17:214).

The Armed Services Board of Contract Appeals (ASBCA) ruled in favor of Texas Instruments and acknowledged acceptance of the company's product line accounting system and "that CAS 401 did not require estimating, accumulating and reporting by individual contract" (17:215).

The following excerpt from the Board's decision provides more insight on their opinion of product line accounting systems.

Accounting systems which accumulate costs by parts or products are fairly common and have no inherent disadvantages which would yield costs in any way less accurate than those generated by job order cost systems. We have no knowledge of the details of TI's cost accounting system and its susceptibility to audit verification by DCAA. However, the ASBCA decision contains nothing which would

suggest any problems for government auditors. If TI's project costs can be satisfactorily audited and the DD Forms 633 adequately supported, we find some difficulties in understanding the purpose of the government effort to require TI to incur the additional expense required to arrive at artificial amounts for individual contracts (17:215).

The full text of the Board's opinion appears in the Cost Accounting Standards Guide (1979). Excerpts from the opinion in regards to the details of Texas Instruments product line accounting system are discussed.

The lowest organizational unit is a project which manufactures identical or similar products, based on commonality of subassemblies, parts, etc. regardless of the origin of the order for the product (16:9340). Appellant's computerized cost accounting system is built on the project organization (16:9340).

2400 project accounts are maintained in the company's cost accounting system (16:9340). "A job order is a specific account number used to identify a particular cost objective usually a discrete task in engineering or the manufacture of a specific lot" (16:9340). Each job order number "identifies individual runs or releases for a particular part" (16:9340). A work order is a type of job order that collect the "material and manufacturing labor costs or fabricating, assembling, and testing parts, subassemblies, and assemblies" (16:9340).

Normally only one part number (which may be an individual part, subassembly, or final assembly) is made on an individual work order (16:9340). General work orders (GWO) collect the direct costs of a project which are general in nature or which cannot be charged economically or efficiently to a particular part number (16:9340). Throughout the manufacturing cycle, the specific job orders

are identified to the particular part or assembly. Through the appropriate work orders the direct manufacturing and engineering labor is thus directly charged to a part or assembly (16:9340).

In regards to the company's handling of overhead costs, the opinion indicates overhead is accumulated in five overhead pools and are allocated to cost objectives on the basis of the respective type of direct labor incurred by such cost objectives (16:9341). The following statements from the Opinion provide insight on how cost reporting is accomplished by the company.

Appellant is able to obtain unit costs for manufactured parts or products through run cost reports (16:9341-9342). These reports are based on the computerized bill of materials for the particular product or part which, in a "Christmas Tree" structure, lists each subassembly and part (16:9342). The "Parts Run Cost Report" lists sequentially all TI-produced part numbers that go into an end item and displays the total cost of producing that part and all lower level parts comprising that part (16:9342).

These company cost run reports are used to provide estimates of proposed costs and record incurred costs during contract performance (16:9345).

In summary, the ASBCA accepted Texas Instruments' cost accounting practices in estimating, accumulating, and reporting costs on a product line basis (16:9354). The purpose of reviewing this company's cost accounting system for government spare parts contracts is not to promote it. However, this published case offered the opportunity to present in detail how one company treats spare parts as

cost objectives. There are probably many variations of this type of product line cost accounting system in use today by other companies. TI's product line accounting system is an example of a spare parts accounting system that is referred to in the research survey in chapter 3.

Commercial vs. Government Spare Parts Costing

Anderson discusses the differences between costing for commercial products and government contracts (18:9-4).

In a commercial market, the usual cost categories are: (1) direct material; (2) direct labor; and (3) indirect manufacturing costs (overhead)" (16:9-5). On the other hand, government contract cost categories are: (1) direct material; (2) direct labor; (3) other direct costs; and (4) indirect costs: (a) material overhead; (b) engineering overhead; (c) manufacturing overhead; and (d) general and administrative expense (16:9-5).

Anderson states there are three main reasons for the differences between government and commercial cost categories (18:9-5). The first reason is in government contracts, "the focal point of cost accumulation is the contract rather than the product" (18:9-5). Companies also probably follow this philosophy with regards to spare parts contracts. However, as explained earlier, Texas Instruments Inc., is one example of a company that estimates, accumulates, and reports costs using a product line accounting system for government spare parts contracts.

Anderson states the second reason for the difference in cost categories has to do with "what is included in the fair

share of indirect costs" (18:9-5). Commercial costing of a product includes direct material, direct labor and share of manufacturing overhead. General and administrative (G&A) expenses along with other indirect costs are charged to the income statement. However in government contracts, contract costing absorbs all company indirect costs, including a share of the G&A expense. In turn, these contract costs are then distributed to the individual spare parts.

"The third reason for the differences in cost categories is the cost-based pricing method used in negotiated government contracts" (18:9-6). Under this method, the contractor's cost to perform the contract is first determined. Then, a profit margin is negotiated between the government and the contractor to determine the price of the contract. On the other hand, companies selling commercial products first determine manufacturing costs, G&A expenses, and selling expenses. Then a profit margin is added to determine price only after considering competitive market forces.

Summary

The cost allocation process includes three basic factors: determining the cost objective, choosing the number of cost pools, and selecting an allocation base for each cost pool to relate the cost pool to the cost objective. All three factors must be considered in order to adhere to the concept of homogeneity. The opinions of accounting

professionals enumerated in this chapter promote the use of departmentalization of overhead to achieve more accurate costing of products. Spare parts rather than contracts as cost objectives will require a close examination of whether cost pools are homogeneous. This examination may lead to an increased number of cost pools in keeping with the concept of homogeneity and departmentalization of overhead. Of course, there is a cost for this increased level of homogeneity. Spare parts as cost objectives will be of little value if the allocation changes do not materially affect the pricing of spare parts and contribute to unit price integrity. Essentially, the number of cost pools and level of homogeneity is a cost benefit decision. That is, the increased accuracy and benefits from determining spare part unit costs must exceed the costs for achieving the increased level of homogeneity or additional cost pools. A survey designed to measure the costs and benefits of treating spare parts as cost objectives will be examined in the following chapters.

III. Methodology

Justification

A mail survey was designed to answer the research and investigative questions. The primary reason this method was selected was its ability to question respondents who are dispersed in various geographical locations throughout the United States. In addition, the nature of the questions were of sufficient detail that a telephone interview was not practical. The survey also allows the respondents to answer in an anonymous manner considering the sensitivity of the questions.

Instrument

No known survey instrument was already available to help answer the research question. The research question is to determine if it is feasible to have spare parts become the cost objectives in government spare parts contracts.

The survey begins with a brief description of a spare parts accounting system that treats spare parts as final cost objectives (Appendix A). This description serves as a frame of reference to help the respondent answer the questions. Wording of the questionnaire was chosen carefully and is consistent with the terminology found in the Cost Accounting Standards. The description of the accounting system addresses the fundamental issue of

treating spare parts as cost objectives and does not pretend to explain all the specific details of the proposed accounting system. Accordingly, the survey questions are commensurate with the survey description of the spare parts accounting system. AFCMD evaluated the content validity of the survey. Key to understanding the survey is the proposed accounting system's handling of indirect costs for spare parts. The survey description provides specific guidance for determining the number of cost pools. The survey also distinguishes between the initial or setup costs to convert to the proposed accounting system and the recurring costs once the system is operational in the company. Also differentiated is the contract proposal estimating costs for spare parts and the accumulating costs to record spare parts costs during contract performance.

Sample

25 large defense companies were selected to participate in this research (Appendix B). This judgement sample consisted of all defense companies with an Air Force Plant Representative Office (AFPRO). The government cost allocation specialist located at the AFPRO administered the survey to the company comptroller or company representative most knowledgeable about the firm's cost accounting system for spare parts.

A possible stumbling block is the contractor's willingness to answer the survey. A company may not want to reveal its cost accounting practices for spare parts, especially considering the recent adverse publicity on defense companies. Anonymous replies, hopefully, will promote a good response.

The sampling plan is a nonprobability sampling plan since judgement was exercised in picking the companies to participate in the survey: companies that have an AFPRO. Nonprobability sampling plans prevent generalizing to a population parameter. Since this research can be best described as exploratory, there is no need to generalize to a population parameter. However, companies expected to participate in the survey are among the largest companies in the defense industry. Their opinions are extremely valuable on any proposed change in cost accounting for government spare parts contracts.

Data Collection

Survey questions follow the description of the spare parts accounting system that treats spare parts as cost objectives (Appendix A). No classification type questions about the company (i.e. sales, products, etc.) were included in the survey. These type questions were excluded to increase respondent's confidence that survey answers were anonymous.

Question 1 asks the contractor if he presently uses a spare parts accounting that treats spare parts as cost objectives. If the contractor answers yes to question 1, he is then directed to questions 16 and 17 to evaluate this accounting system. Question 2 and 3 identify the initial cost to modify the company's accounting system to treat spare parts as cost objectives. Questions 4 through 9 refer to the direct cost categories of spare parts accounting. These questions also differentiate between contract proposal estimating costs and accounting costs to accumulate or record costs during contract performance. Spare parts as cost objectives would require compliance with CAS 401, Consistency in Estimating, Accumulating and Reporting Costs. The standard states "the contractor's practices used to estimate costs in pricing proposals must be consistent with practices used in accumulating actual costs" (20:819).

Questions 10 through 13 refer to the company's indirect costs. These questions also differentiate between estimating and accumulating costs. Question 14 and 15 refer to the company's general and administrative expense.

For question 16, the respondent provides a subjective assessment of the cost benefit trade-off of operating a spare parts accounting system. Question 17 asks for respondents' attitudes on the accuracy of determining the overall contract cost with a spare parts accounting system

as compared to contract cost objective accounting. Questions 16 and 17 also provide an opportunity for the respondent to express his views on treating spare parts as cost objectives.

Analysis Plan

Questions 2 through 15 consist of multiple-choice questions. A Likert-type scale was developed for the response categories: very low (under 15%), low (16%-25%), moderate (26%-50%), high (51%-100%), extremely high (100%-200%), and other (specify ____%). The strategy behind the response categories is to determine the cost impact on the company of implementing a type of spare parts accounting system that treats spare parts as cost objectives. The percentages in parenthesis next to each response category serve as a frame of reference for the respondent. The objective of the response categories is not to secure precise measurements. Rather, it is to uncover relationships or extremes in variations in the responses. Data will be reported as percentages or numbers. Opinions expressed by respondents in questions 16 and 17 will also be discussed. Answers to investigative questions and research conclusions will be based on where the count data clusters in the response categories.

Assumptions

The survey cover letter instructed the AFPRO to give

the questionnaire to the contractor representative most knowledgeable about cost accounting and estimating of government spare parts contracts. Company representatives answering the survey are assumed to be knowledgeable and experts on their respective company's cost accounting system.

Limitations

The primary limitation is the sample size since there are only 25 AFPROs available to be contacted to participate in the survey. The proposed spare parts accounting system addresses fundamental issues and is not a comprehensive description of the accounting system. Another limitation is the composition of the defense contractors participating in the survey. They represent the largest companies in the defense industry. The survey results obtained from these large defense companies may not be similar to the results obtained by smaller companies engaged in spare parts contracts with the government. Thus the results of the survey should be interpreted accordingly and extreme caution should be exercised in attempting to apply the conclusions to the total population of defense contractors.

IV. Findings and Analysis

Introduction

12 of the 25 defense contractors replied to the survey for a response rate of 48 percent. 2 of the 12 contractors responding chose to do so in a narrative format. Although, not required by the survey instructions, 7 of the 12 responding contractors identified their company name on the survey replies. Responses to the survey are summarized and reported in Appendix A. Only survey question 1 includes the responses from the two contractors who answered in a narrative format. Questions 16 and 17 also ask respondents to explain their views on treating spare parts as cost objectives. These views, along with the two contractors who responded to the survey in a narrative format, will be presented in the analysis that follows in this chapter.

The findings of the survey will be presented in a manner corresponding to the investigative questions listed in chapter 2.

Investigative Question 1

The first investigative question is: Do any large defense companies presently use a type of spare parts accounting-cost accounting system that treats spare parts as cost objectives in order to determine unit costs? An analysis of survey question 1 was necessary to answer this question.

5 of the 12 (42 percent) defense contractors reported using a type of spare parts accounting system as described in the survey. Within that group, 1 of the 5 contractors qualified their answer. This company stated they treat spare parts as cost objectives only for replenishment spares while initial or provisioning spares are integrated with production of the respective new weapon system. The company further remarked their accounting procedures are not conducive to treating spare parts as cost objectives when spares are integrated with production of the weapon system. Also, the company's lack of historical data contributed to not treating spare parts as cost objectives.

The answer to Investigative Question 1 is yes there are some major defense contractors treating spare parts as cost objectives as outlined in the survey description.

The 5 companies presently not using a type of spare parts accounting system will be analyzed in investigative questions 2, 3, 4, and 5 to determine the cost impact of converting to such a system.

Investigative Question 2

The second investigative question is: What will be the initial cost impact on a company's estimating practices if spare parts are treated as final cost objectives? An analysis of survey question 2 was necessary to answer this question. Within that group, one respondent chose the "very low (under 15%)" alternative, one respondent chose "low

(16%-25%)", one respondent chose "high (51%-100%)", and two respondents chose "extremely high (101%-200%)". In addition, the researcher made a subjective assessment of two additional replies made by two companies in a narrative format. Both of these narratives gave the impression that the initial or setup cost would be "high (51%-100%)" to modify the company's cost estimating methods to treat spare parts as cost objectives.

The answer to the second investigative question is the data supports the conclusion that the initial cost impact would be in the "high (51%-100%)" to "extremely high (101%-200%)" range for a company to modify its cost estimating methods to treat spare parts as cost objectives.

Investigative Question 3

The third investigative question is: What will be the initial cost impact on a company's cost accumulating practices if spares are treated as cost objectives? An analysis of survey question 3 was necessary to answer this question. Of the five companies responding to this question, one respondent chose the "moderate (26%-5%)" alternative and four respondents selected the "extremely high (101%-200%)" alternative. The two narrative responses gave the researcher the impression that the initial costs would be in the "high (51%-100%)" range for these companies to modify their cost accumulating methods to treat spare parts as cost objectives.

The answer to the third investigative question is the data supports the conclusion that the initial cost impact would be "extremely high (101%-200%)" for a company to modify its cost accumulating methods to treat spare parts as cost objectives.

Investigative Question 4

The fourth investigative question is: What will be the recurring cost impact on a company's cost estimating practices if spare parts are treated as final cost objectives? To answer this question, survey questions 4, 6, 8, 12, and 14 were analyzed. Survey results for these questions are summarized next to the appropriate question in Appendix A. Respondents selected response categories mostly in the "very low (under 15%)" to "low (16%-25%)" range for each of these survey questions. Summation of the count data for this series of questions results in the following totals: 9 responses for "very low (under 15%)", 9 responses for "low (16%-25%)", 3 responses for "moderate (26%-50%)", 3 responses for "high (51%-100%)", 1 response for "extremely high (101%-200%)", and there were no responses in the "other" category. The two narrative responses expressed concern over significant increases in overall accounting costs if spare parts are treated as cost objectives and did not address specifically increases in estimating costs. However, estimating costs are less labor intensive than accumulating or recording costs. The accumulating of costs

is also a repetitive type function. Thus the researcher is hesitant to say these two companies would experience estimating costs in the "high (51%-100%)" or higher range.

The answer to investigative question 4 is, the data supports the conclusion that recurring estimating costs of a company would increase in the "very low (under 15%)" to "low (16%-25%)" range if spare parts were treated as cost objectives.

Investigative Question 5

The fifth investigative question is: What will be the recurring cost impact on a company's cost accumulating practices if spare parts are treated as final cost objectives? To answer this question, survey questions 5, 7, 13, 15 were analyzed. Survey results for these questions are summarized in the response categories of the appropriate question in Appendix A. No extremes in the count data were evident in the response categories. However, 3 of the 5 respondents selected the "high (51%-100%)" alternative for survey question 13. This survey question refers to the anticipated increase in accumulating costs for indirect costs. Apparently, the respondents believe any increase in the number of indirect cost pools will cause accumulating costs to rise significantly. Summation of the count data for this series of questions results in the following totals: 6 responses for "low (16%-25%)", 8 responses for

"moderate (26%-50%)", 8 responses for "high (51%-100%)", and 3 responses for "extremely high (101%-200%)". There were no responses recorded for "very low (under 15%)" or "other" alternatives. The researcher believes the 2 narrative responses can best be expressed in the "high (51%-100%)" range.

In addition, respondents were asked to report the number of indirect cost pools typically used to allocate overhead to spare parts contracts (question 10) and the percentage increase in the number of pools if spare parts are treated as final cost objectives. The number of current pools and the anticipated percentage increase were reported as follows: 12 pools; "very low (under 15%)", 7 pools; "moderate (26%-50%)", 5 pools; "low (16%-25%)", 4 pools; "high (51%-100%)". What's noticeable in this range of data is as the number of current cost pools increases among the companies, the anticipated percentage increase in cost pools decreases with one exception. The company reporting 5 pools; "low (16%-25%)" did not fit this trend exactly. Also 1 company failed to provide the number of current cost pools. Thus it appears that companies already having a relatively high number of cost pools can more readily adapt their indirect cost accounting to treating spare parts as cost objectives.

The answer to investigative question 5 is difficult to determine with any confidence. No extremes in the response

categories are evident. However, the 4 survey responses along with the 2 narrative responses collectively support the conclusion that recurring accumulating costs of a company would increase in the "moderate (26%-50%)" to "high (51%-100%)" range.

Investigative Question 6

The sixth investigative question is: Does treating spare parts as final cost objectives provide a more cost effective alternative of determining more accurate unit prices compared to contract cost objective accounting? To answer this question survey question 16 was analyzed. This question will be analyzed between those respondents who answer yes or no to survey question 1 which asked if the company presently uses a spare parts accounting system.

Not surprisingly, 4 of the 5 companies (excluding the two narrative responses) who responded "no" to survey question 1 also selected the "strongly agree" alternative to survey question 16. These respondents "strongly agree" that the costs outweigh any benefits in operating a spare parts cost accounting system. The following 4 statements were provided by each of respondents to explain their "strongly agree" response:

A spare parts cost accounting system would only drive the cost of spares higher. This contractor would prefer not to have any spares business since buys are not made in economical quantities. We do it only as a customer convenience not for profit.

Over many decades, statistics gathered from actual costs, plus engineering data, have enabled this contractor to develop cost estimating relationships for functions involved which are used in the estimating process. These relationships are tested from time to time and invariably are proven valid.

The accounting for spare parts would require many decisions in allocation of cost to the part level. This would not necessarily reflect the true cost of the item although total contract cost would be accurate. The additional time and computer cost required would not be justified for any benefit obtained.

Base material dollars and touch labor hours are already intrinsically related to each spares line item. Less intrinsic performance indexes, attrition rates, misc. direct cost "CERS" and overheads would not change significantly at a line item level.

As the above responses indicate, costs would exceed benefits in implementing a spare parts accounting system. The other company presently not using a spare parts accounting system selected the "do not agree" alternative to survey question 16 and so did not believe the costs outweigh the benefits in operating this type of system. This company's explanation to survey question 16 is reprinted below.

If a parts cost system is the inherent basis of the cost system the roll up of direct costs is minimal based on average actuals for each lot of parts manufactured. Indirect costs if based on applied rates is minimal.

The two narrative responses from companies who do not use a spare parts accounting system also reflected a similar opinion to the above responses. One narrative response stated in regards to the cost impact as "extremely high"

relative to any potential management benefits. The other narrative response, signed by a top executive from one of the largest defense companies, provided a detailed explanation. This response is reprinted below.

There are various classes of spare parts ordering actions, each of which entails unique treatment. Some spare parts procurement is performed in accordance with AFR 800-26, Spare Acquisition Integrated with Production. These are priced as an extension of the production order base, but accounted for as a separate cost objective for the SAIP quantity in total. Provisioning spares are generally produced concurrent with production, though ordering generally occurs during later stages of production after the hardware becomes less prone to change. Provisioning spares are generally accounted for via a cost objective for the entire spares package. Replenishment spares encompass the hardware support throughout the life cycle of the product. They are characterized by short flow times, long intervals between spares production runs, small order sizes and configuration or production process changes. They are accounted for via separate cost objectives based upon contract and delivery schedule, but not by individual part number.

Estimating of spare parts varies for each of the above classes. Both SAIP and provisioning may be estimated via parametric techniques, historical costs at the part number level or detail estimates. Replenishment spares are generally estimated based upon recorded costs at the part number level.

The supposition that establishing final cost objectives for each spares part number might lower the cost of spares acquisitions is naive and unsupported. Admittedly, final cost objective treatment would provide a vehicle for comparison or recorded cost of the original priced value after the fact; but this can be accomplished in the current environment via analysis. It is unlikely that the results of such an exercise would prove fruitful. Spares parts are estimated using the best tools and techniques available, and are subject to the same or greater reviews as production estimates. The few documented cases of substantial overpricing of spares is offset by an equal number

of underpricing events. The end result being that few, if any, contractors rely upon spares acquisitions as a primary source of profits.

If each spares order were treated as a final cost objective, the result would be that spares would have more accounting records than the remainder of our business activity. Furthermore, even though the period of performance on spares orders is very short, final cost objectives must be maintained in the accounting system until final annual overhead rates are negotiated, which may be several fiscal years later.

Though the impact to spares due to a CAS 418 review is probably immaterial from an accounting perspective, if spares orders were allowed to absorb full cost of administrative and logistics support, the cost of spare parts would increase dramatically. Spares require as much planning, scheduling and administrative support for a small quantity, short flow order as is incurred for production orders of much greater volume. In addition to support and logistics cost, spares orders generally incur a higher set up to run time ratio due to smaller order sizes.

In summary, we do not feel that spares estimating should be done any differently than the current practice. Nor should we entertain the proposal that separate cost objectives be established for each spares end item part number. Provisioning and replenishment spares activity constitute a high volume of contractual orders, but only about 2 percent of government sales (and earnings). The costs of such discrete accounting would impose a burden which would be far greater than any benefits which might be derived.

The above contractor response addresses other factors besides cost allocation which will not be discussed. The contractor gives the impression that spare parts as cost objectives would turn into an accounting nightmare. The contractor admits spare parts costs can be estimated "at the part number level" but does not want to formalize this

practice into their estimating and accumulating techniques for government contracts.

5 respondents answered "yes" to survey question 1, affirming the use of a type of spare parts accounting system that treats spare parts as cost objectives. Within that group, 2 respondents selected the "strongly agree" alternative, 2 respondents selected the "do not agree" alternative and 1 respondent selected the "strongly disagree" alternative for survey question 16. The 2 "do not agree" and 1 "strongly disagree" respondents are apparently content with operating a spare parts cost accounting system and do not believe the costs exceed the benefits of this type of accounting. One of the "strongly agree" respondents again explains his answer only applies to initial spares accounting and not to replenishment spares. With regards to initial spares the contractor provided the following explanation to survey question 16:

The administrative cost of accounting for cost by individual spare order is extremely high. Disputes often arise as a result of the variability of accumulated cost for like/similar parts. The result is usually a requirement to charge at a lower level part number which is very difficult to accomplish in an accurate fashion.

Besides the high administrative costs, the contractor respondent is concerned with the accuracy of the estimates at the part number level. Apparently the contractor and government representatives are "second guessing" each other as to the best way to allocate costs to spare parts. In

any event, the contractor does treat spare parts as cost objectives for replenishment spares.

The answer to investigative question 6, based on data from 6 of the 7 companies (including the 2 narrative responses) who do not use a spare parts accounting system, is unfavorable to treating spare parts as cost objectives. These companies believe the costs exceed the benefits of implementing such a system. On the other hand, 3 of the 5 who do use a spare parts accounting system are satisfied with it. Another respondent of that group of 5 uses the system for replenishment spares. This leaves only one respondent who uses a spare parts accounting system and expresses total dissatisfaction or the costs exceed the benefits. The researcher can only conclude that treating spare parts as cost objectives may be cost effective depending on the individual circumstances of each company. No generalizations cannot be made without considering company attributes. In addition, respondents may be bias towards there own accounting system and may react unfavorably to any proposal to change accounting practices. This bias may be reflected in respondents' answers.

Investigative Question 7

The seventh investigative question is: Does treating spare parts as cost objectives have an impact on the overall accuracy of the estimated contract price? To answer this question survey question 17 was analyzed. The count data

from the 10 respondents who answered this question is summarized next to survey question 17 in Appendix A. The two narrative responses did not address this question. 4 out of the 5 respondents presently using a spare parts accounting system also believe this system does not provide a less accurate estimate of the overall contract cost. Only 1 respondent of this group of 5 "agree somewhat" that this system provides a less accurate estimate of the overall contract costs. This contractor's explanation was "the cost of spare parts are much more variable than an entire contract cost objective and therefore much more difficult to estimate."

On the other hand, those companies presently not using a parts accounting system answer this question with mixed results. Within this group of 5, 1 respondent chose the "strongly agree" alternative, 2 respondents selected the "do not agree alternative, and 2 respondents selected the "no difference alternative. The "strongly agree" respondent stated:

You end up allocating allocations and only end up driving the cost higher. Spares are a necessary evil and should be administered in the most efficient manner.

The two "do not agree" respondents stated:

We would gain some "line item" level accuracy while increasing total cost of spares. The increase would result from the administrative costs associated with maintaining a spare parts cost accounting system.

If the contract accounting is built upon parts cost then there is no significant large impact.

The two "no difference" respondents stated:

The validity of the relationships have been proven. Attempts to set up a spare parts cost accounting system would, at best, only prove what we already know and, at worst, introduce an element which would cause confusion.

While the accounting may not be less accurate, I don't believe it would be more accurate since allocation of some cost would be very difficult to accurately charge at this level. This great volume of data would therefore be suspect at the part level, but a true accounting at the contract level.

The answer to investigative question 6 based on the data is that a majority (8 out of 10) of the respondents do believe a spare parts accounting system provides a less accurate estimate of the overall contract price than contract cost objective accounting.

V. Conclusions and Recommendations

Introduction

This exploratory research was conducted in an attempt to answer the following research question: Is it feasible to have spare parts become the cost objectives in government spare parts contracts? Investigative questions were formulated to address this fundamental issue and not to secure precise data. Despite the small sample size of 12 respondents, the goal was not to obtain a representative cross-section view from defense contractors. Rather, by surveying some of the largest defense contractors, insight could be obtained on this proposal of treating spare parts as cost objectives. A review of the material previously presented in chapter 4 will provide the basis of concluding this research.

Review

To the researcher's surprise 5 of the 12 respondents admitted to using a type of spare parts accounting system as described in the survey (survey question 1). Apparently some companies are treating spare parts as cost objectives within the larger cost objective of the contract. Chapter 3 of this research presentation reported on Texas Instruments as an example of a company which treats spare parts as cost objectives. However, the research found no

published research on other companies following this practice in recent history.

6 of the 7 companies in the survey not treating spare parts as cost objectives were unfavorable to changing to this system. In terms of initial costs, these companies projected "extremely high (100%-200%)" changeover costs to start accumulating costs for spare parts as cost objectives. Also, a "high (51%-100%)" to "extremely high (100%-200%)" range was projected for changeover costs for estimating costs. In terms of recurring costs, cost increases in the "moderate (26%-50%)" to "high (51%-100%)" range were also anticipated in accumulating costs for spare parts. These companies also thought the cost impact would be less severe in recurring estimating costs: "very low (under 15%)" to "low (16%-25%)" range. The survey introduction stated clearly "the creation of additional indirect cost pools should be required if the changes result in materially different allocations of cost to spare parts." Apparently these companies expect this requirement to be a cost burden without any measurable benefit. This opinion also was reflected in the responses to survey question 16 where contractor explanations were provided and reprinted in chapter 4 for the reader.

Conversely, only 1 of the 5 contractor respondents presently using a type of spare parts accounting system expressed total dissatisfaction with the system. This

contradictory research can only lead the researcher at this point to conclude that the type of accounting system employed by the contractor respondents is tailored to the individual company's needs. Bias towards their own accounting system may have also influenced respondents favoring their own type of accounting system. Further, companies presently not using a spare parts accounting system may have exaggerated in their survey answers the cost of implementing such a system. On the other hand, companies presently using a spare parts accounting system may have overstated the benefits of this system in relation to accumulating and estimating costs. Spare parts as cost objectives works for some companies and in other companies it is viewed unfavorable. This research has shown that treating spare parts as cost objectives is not absurd or unreasonable and may indeed be feasible for some companies.

Recommendations

The costs and benefits of treating spare parts as cost objectives needs further examination. Increased understanding by government and contractor personnel on how a spare parts accounting system works in practice may also alleviate the fears of those presently not using this system. The 5 contractor respondents in this survey who treat spare parts as cost objectives may be a starting point to look at this issue in more detail. Of course, a critical prerequisite to further detailed study is willingness by

defense contractors to disclose adequate information. The student researcher may not be in the best position to obtain this data. Air Staff pricing personnel (HQ USAF/RDCP) may provide suggestions to carry out more detailed research.

Automated cost accounting systems also hold promise in providing package computer software to automate costing of spare parts. These systems are based on detailed product structure data base files. An examination of the potential benefits of these systems may prove fruitful.

Appendix A: Survey Questionnaire

LSQ (Capt Yorke, AV 785-5435)

Spare Parts Accounting Questionnaire

All AFCMD Detachments/TM

1. This survey is part of an AFIT research project designed to measure the feasibility of treating spare parts as cost objectives in government contracts. Contractor's answers are critical to the project.

2. Please give this letter and questionnaire to the contractor representative most knowledgeable about cost accounting and estimating of government spare parts contracts. Ask the representative to complete the attached questionnaire and return it to me in the enclosed envelope by 13 June 1986.

2. Only a few minutes are needed to answer the questions. Contractor responses are anonymous and participation is voluntary. If the contractor wishes a summary of the study, he also needs to complete and mail separately the attached return card. Please thank the contractor for his cooperation in this educational endeavor.

John A. Long, Lt Col, USAF
Head, Dept of Quantitative Management
School of Systems and Logistics

3 Atch
1. Questionnaire
2. Return Envelope
3. Return Card

SPARE PARTS ACCOUNTING QUESTIONNAIRE

We define a spare parts cost accounting system as one that treats spare parts as final cost objectives. A separate measurement or unit cost is provided for each spare part that is deliverable under the supply contract. Unit cost includes (1) direct costs that can be specifically identified with the spare parts and (2) indirect costs or overhead. The determination of the number of indirect cost pools is governed by Cost Accounting Standard (CAS) 418 with the added condition that the spare parts are the cost objectives. That is, the creation of additional indirect cost pools should be required if the changes result in materially different allocations of cost to the spare parts. Unit cost also includes an allocation of contract (3) general and administrative expense. Thus, the determination of cost of a spare part is embedded in the cost accounting system. Spare part unit cost is equivalent to the average unit cost in producing a certain quantity or lot of the spare part.

This system applied to supply contracts results in each spare part and its respective quantities represented as a contract line item on the contract price proposal for spare parts. Estimating costs for a contract proposal for spare parts consist of the estimated cost for each spare part line item. Similarly, the accumulating costs for the contract during contract performance consist of the accumulated cost for each spare part line item.

Assume you are the prime contractor preparing a contract proposal for spare parts for a system that has recently been fielded. The survey questions ask you to estimate the cost impact and any benefits realized in modifying your present estimating methods and accounting system to a spare parts accounting system that treats spare parts as final cost objectives.

1. Do you presently use for government spare parts contracts a type of spare parts cost accounting system as described above to determine unit costs for spare parts?

5 a. yes

7 b. no

If you answer yes to question 1 please go to question 16 and continue. If you answer no, then go to question 2 and continue.

2. Describe best the initial or setup cost to modify your present cost estimating methods to treat spare parts as cost objectives in a contract proposal for spare parts.

1 a. very low (under 15%)

1 d. high (51%-100%)

1 b. low (16%-25%)

2 e. extremely high (101%-200%)

 c. moderate (26%-50%)

 f. other (specify %)

3. Describe best the initial or setup cost to modify your present cost accumulating methods to treat spare parts as cost objectives during contract performance?

- | | |
|-------------------------------------|----------------------------------------------|
| <u> </u> a. very low (under 15%) | <u> </u> d. high (51%-100%) |
| <u> </u> b. low (16%-25%) | <u> 4 </u> e. extremely high (101%-200%) |
| <u> 1 </u> c. moderate (26%-50%) | <u> </u> f. other (specify <u> </u> %) |

All further questions refer only to recurring costs once a spare parts accounting system is operational. Answer questions concerning cost increases relative to your current estimating or accumulating costs.

4. Describe best the increase in your contract proposal estimating costs for direct materials if they are estimated for each spare part line item.

- | | |
|--------------------------------------|----------------------------------------------|
| <u> 2 </u> a. very low (under 15%) | <u> 1 </u> d. high (51%-100%) |
| <u> 2 </u> b. low (16%-25%) | <u> </u> e. extremely high (101%-200%) |
| <u> </u> c. moderate (26%-50%) | <u> </u> f. other (specify <u> </u> %) |

5. Describe best the increase during contract performance in your accounting costs for direct materials if they are accumulated for each spare part line item.

- | | |
|-------------------------------------|----------------------------------------------|
| <u> </u> a. very low (under 15%) | <u> 1 </u> d. high (51%-100%) |
| <u> 1 </u> b. low (16%-25%) | <u> 1 </u> e. extremely high (101%-200%) |
| <u> 2 </u> c. moderate (26%-50%) | <u> </u> f. other (specify <u> </u> %) |

6. Describe best the increase in your contract proposal estimating costs for direct labor if it is estimated for each spare part line item.

- | | |
|--------------------------------------|----------------------------------------------|
| <u> 2 </u> a. very low (under 15%) | <u> 1 </u> d. high (51%-100%) |
| <u> 2 </u> b. low (16%-25%) | <u> </u> e. extremely high (101%-200%) |
| <u> </u> c. moderate (26%-50%) | <u> </u> f. other (specify <u> </u> %) |

7. Describe best the increase during contract performance in your accounting costs for direct labor if it is accumulated for each spare part line item.

- | | |
|-------------------------------------|----------------------------------------------|
| <u> </u> a. very low (under 15%) | <u> 2 </u> d. high (51%-100%) |
| <u> 1 </u> b. low (16%-25%) | <u> 1 </u> e. extremely high (101%-200%) |
| <u> 1 </u> c. moderate (26%-50%) | <u> </u> f. other (specify <u> </u> %) |

8. Describe best the increase in your contract proposal accounting costs for other direct costs if they are estimated for each spare part line item.

- | | |
|--------------------------------------|----------------------------------------------|
| <u> 1 </u> a. very low (under 15%) | <u> </u> d. high (51%-100%) |
| <u> 2 </u> b. low (16%-25%) | <u> 1 </u> e. extremely high (101%-200%) |
| <u> 1 </u> c. moderate (26%-50%) | <u> </u> f. other (specify <u> </u> %) |

9. Describe best the increase during contract performance in your accounting costs for other direct costs if they are accumulated for each spare part line item.

- | | |
|----------------------------------|--------------------------------------------|
| <u>2</u> a. very low (under 15%) | <u>1</u> d. high (51%-100%) |
| <u>1</u> b. low (16%-25%) | <u>1</u> e. extremely high (101%-200%) |
| <u>1</u> c. moderate (26%-50%) | <u> </u> f. other (specify <u> </u> %) |

10. How many indirect cost pools are typically used to allocate overhead to spare parts contracts in your present accounting system 7, 4, 5, 12, blank.

For questions 11-13, again, the creation of additional indirect cost pools should be required only if the changes result in materially different allocations of cost to spare parts.

11. Describe best the increase in the number of additional indirect cost pools if spare parts are treated as final cost objectives. Answer this question relative to your answer in question 10.

- | | |
|----------------------------------|--------------------------------------------|
| <u>2</u> a. very low (under 15%) | <u>1</u> d. high (51%-100%) |
| <u>1</u> b. low (16%-25%) | <u> </u> e. extremely high (101%-200%) |
| <u>1</u> c. moderate (26%-50%) | <u> </u> f. other (specify <u> </u> %) |

12. Describe best the increase in your contract proposal accounting costs for indirect costs if estimated costs in indirect cost pools are allocated to each spare part line item.

- | | |
|----------------------------------|--------------------------------------------|
| <u>2</u> a. very low (under 15%) | <u>1</u> d. high (51%-100%) |
| <u>2</u> b. low (16%-25%) | <u> </u> e. extremely high (101%-200%) |
| <u> </u> c. moderate (26%-50%) | <u> </u> f. other (specify <u> </u> %) |

13. Describe best the increase during contract performance in your accounting costs for indirect costs if accumulated costs in indirect cost pools are allocated to each spare part line item.

- | | |
|------------------------------------|--------------------------------------------|
| <u> </u> a. very low (under 15%) | <u>3</u> d. high (51%-100%) |
| <u>1</u> b. low (16%-25%) | <u> </u> e. extremely high (101%-200%) |
| <u>1</u> c. moderate (26%-50%) | <u> </u> f. other (specify <u> </u> %) |

14. Describe best the increase in your contract proposal accounting costs for general and administrative (G&A) expense if estimated costs in G&A pools are allocated to each spare part line item.

- | | |
|----------------------------------|--------------------------------------------|
| <u>2</u> a. very low (under 15%) | <u> </u> d. high (51%-100%) |
| <u>1</u> b. low (16%-25%) | <u> </u> e. extremely high (101%-200%) |
| <u>2</u> c. moderate (26%-50%) | <u> </u> f. other (specify <u> </u> %) |

15. Describe best the increase during contract performance in your accounting costs for G&A expense if accumulated costs in G&A pools are allocated to each spare part line item.

- | | |
|------------------------------------|--------------------------------------------|
| <u> </u> a. very low (under 15%) | <u> 1 </u> d. high (51%-100%) |
| <u> 1 </u> b. low (16%-25%) | <u> </u> e. extremely high (101%-200%) |
| <u> 3 </u> c. moderate (26%-50%) | <u> </u> f. other (specify <u> </u> %) |

For statements 16 and 17, please indicate the degree of your agreement or disagreement.

16. The cost of operating a spare parts cost accounting system exceed any benefits in accuracy in determining unit costs of spare parts when compared to contract cost objective accounting and associated pricing methods.

- | | |
|--------------------------------|-----------------------------------|
| <u> 6 </u> a. strongly agree | <u> 3 </u> d. do not agree |
| <u> </u> b. agree somewhat | <u> 1 </u> e. strongly disagree |
| <u> </u> c. undecided | <u> </u> f. no difference |

Explain briefly your answer:

17. A spare parts cost accounting system for spare parts contracts provides a less accurate estimate of the overall contract cost than contract cost objective accounting.

- | | |
|--------------------------------|-----------------------------------|
| <u> 1 </u> a. strongly agree | <u> 4 </u> d. do not agree |
| <u> 1 </u> b. agree somewhat | <u> 1 </u> e. strongly disagree |
| <u> </u> c. undecided | <u> 3 </u> f. no difference |

Explain briefly your answer:

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VITA

Captain Micahel O. Yorke was born on 14 May 1953 in Douglaston, New York. He graduated from Cardozo High School in Bayside, New York in 1971. He received a Bachelor of Science degree in Education from Manhattan College, Bronx, New York in June, 1975. He entered the United States Air Force and received his commission from Officer's Training School in September of 1979. Captain Yorke was assigned to Moody AFB as a Base Supply Officer. While stationed at Moody AFB, Captain Yorke received a Master's degree in Business Administration from Valdosta State College in December 1982. From February 1983 through April of 1985, Captain Yorke was assigned to HQ Space Command, Supply Directorate, as an Acquisition Management Officer. He entered the School of Systems and Logistics, Air Force Institute of Technology, in May 1985.

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The research objective was to determine if it is feasible to treat spare parts in lieu of contracts as cost objectives in government spare parts contracts. A survey instrument was constructed to help answer the research question. Survey was administered to contractor representatives of 12 major defense companies.

The analysis revealed that 5 defense contractors are presently treating spare parts as cost objectives and using a type of spare parts accounting system as described in the survey instrument. The other 7 contractor respondents who do not treat spare parts as cost objectives were not favorable to this accounting treatment. Also within this group, most anticipated significant increases in accumulating contract costs in order to treat spare parts as cost objectives. The anticipated cost impact was less severe in estimating contract costs.

The results of this exploratory research based on the limited data from a small number of large defense contractors supports the conclusion that treating spare parts as cost objectives is feasible for some companies. However, more detailed research is required to fully assess the impact and practicality of treating spare parts as cost objectives.

END

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